Light and Lighting

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Bright Light Sources

ON pp. 175-176 we give a brief summary of Dr. Aldington's recent paper on the above subject—a fascinating supplement to the first instalment given in the previous I.E.S. Session.

The author now adds to what has been said in regard to filament lamps an account of recent researches on discharge lamps yielding very bright light indeed.

One cannot doubt that these new sources —some only recently brought to fruition, some still in the experimental stage—will have many important applications for example, for signals and in the cinema industry.

Of special interest is the performance of the new flash lamps yielding a very brilliant light for a very short time, which gave rise to some speculation in the discussion.

It was interesting to learn that this is yet another instance of mutual help between the research laboratories of the leading firms in the lighting industry.

I.E.S. Cardiff Centre Forthcoming Dance

We note with pleasure that the I.E.S. Cardiff Centre has made arrangements for a dance, which will be held at the Connaught Rooms, Cardiff, on January 10. The R.A.F. (St. Athan) Dance Orchestra will provide the music. The period of the dance is from 7.30 to midnight, and it will follow after the delivery of the Address of the President (Mr. H. C. Weston) on the afternoon of the same day—thus furnishing an excellent rallying opportunity for members in the South Wales area.

I.E.S. Birmingham Centre Annual Dinner

The annual dinner of the I.E.S. Birmingham Centre, which took place at the Imperial Hotel on December 7, was again a successful event, over 140 members and guests being present.

Mr. F. F. Middleton, Chairman of the Centre, presided. Mr. H. C. Weston (I.E.S. President), Mr. H. Hooper (I.E.E.), Mr. A. Brian Cooper (Birmingham and Five Counties Architects Assoc.), and Mr. T. W. Wood (Assoc. Supervising Elect. Engineers), were amongst the guests. In the speeches various phases of illuminating engineering were discussed, and the value of the work which the Society was doing was strongly emphasised. Mr. Hooper encouraged those present not to be too concerned at prospects of nationalisation, Mr. Brian Cooper, who proposed the toast of the Society, urged the importance of joint action by architects and illuminating engineers, and Mr. H. C. Weston, in responding for the I.E.S., referred to the growth in reputation and responsibility of the Society and congratulated the Birmingham Centre—the largest in the country—on their activities.

International Lighting Exposition

The above exhibition, which was originally planned to take place in Chicago in April last, but was postponed, is now announced to take place during April 25-30, next year. The exhibition is sponsored by the National Electrical Manufacturers' Association, and visitors are invited to "see the latest in the world of lighting." There will be conferences dealing with such matters as the use of light and colour in industrial lighting, new methods of lighting in stores, schools and offices, and other topics. It is stated that an important section of the conferences will be devoted to "sales training in lighting, lighting service and lighting equipment selling." A printed folder giving full particulars of the programme and information in regard to the conferences is now in course of preparation and may be obtained on application to the International Lighting Exposition, 111, W. Jackson Building, Chicago, Illinois, U.S.A.

Forthcoming I.E.S. Meetings

(Provisional List)

SESSIONAL MEETINGS IN LONDON

1946.

Jan. 8th. A Discussion on the **British Standard Specification for Street Lighting** will be introduced by DR. J. W. T. WALSH, MR. F. C. SMITH and MR. J. M. WALDRAM. (*In the Lecture Theatre of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.*1.) **6 p.m.**

Feb. 12th. MR. H. A. ALLPRESS on **The Design and Performance of Industrial Lighting.** (*At the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.*) **6 p.m.**

MEETINGS OF CENTRES AND GROUPS

1946.

Jan. 4th. MR. L. C. RETTIG on **Hospital and School Lighting.** (*At Radiant House, Bristol.*) **7 p.m.**

Jan. 4th. MR. H. J. CULL on **The Physical Nature of Light.** (*At the Imperial Hotel, Temple Street, Birmingham.*) **6 p.m.**

Jan. 4th. DR. J. H. NELSON on **Motor Car Lamps.** (*In the Lecture Theatre of the City of Nottingham Gas Dept., Parliament Street, Nottingham.*) **5.30 p.m.**

Jan. 7th. MR. F. L. CATOR on **Some Aspects of Lighting in the Engineering Industry.** (*At the Electricity Showrooms, The Headrow, Leeds.*) **6 p.m.**

Jan. 8th. MR. F. L. CATOR on **Some Aspects of Lighting in the Engineering Industry.** (*At the Electricity Showrooms, Market Street, Huddersfield.*) **7 p.m.**

1946.

Jan. 9th. MR. H. C. WESTON on **Presidential Address.** (*In the Minor Hall, Oxford Street, Newcastle-upon-Tyne.*) **5.45 p.m.**

Jan. 10th. MR. A. L. RANDALL on **Electric Lamp Manufacture.** (*In the Electricity Dept. Showrooms, Sunbridge Rd., Bradford.*) **6.45 p.m.**

Jan. 10th. MR. F. F. MIDDLETON on **Lighting Pros & Cons.** (*In the Reynolds Hall, College of Technology, Sackville Street, Manchester.*) **6 p.m.**

Jan. 10th. MR. H. C. WESTON on **Presidential Address.** (*In the Cardiff Corporation Showrooms.*) **3 p.m.**

Jan. 10th. MR. T. S. WOOD on **Lighting and Hotel Services on Modern Liners.** (*At the Institute of Engineers and Shipbuilders, 39, Elmbank Street, Glasgow C.*2.) **7 p.m.**

Jan. 11th. MR. W. ALLEN on **Daylight Design Practice.** (*At the Heriot-Watt College, Chambers Street, Edinburgh* 1.) **6 p.m.**

Jan. 16th. Address by Chairman of Group, MR. E. ANDERSON. (*At the Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.*) **6 p.m.**

Jan. 17th. MR. A. G. HOLTAM, on **Factors Affecting the Efficient Working of Gas Street-Lighting Installations.** (*At Gloucester.*)

Jan. 23rd. MR. J. K. MARSDEN on **Lighting in the Glass Industry.** (*At the Sheffield University, Western Bank, Sheffield.*) **6 p.m.**

Feb. 1st. DR. J. W. T. WALSH on **The Measurement of Light.** (*In the Imperial Hotel, Temple Street, Birmingham.*) **6 p.m.**

Feb. 1st. MR. W. F. PERKINS on **Electrical Distribution as Applied to Illuminating Engineering.** (*In the Lecture Theatre of the City of Nottingham Gas Dept., Parliament Street, Nottingham.*) **5.30 p.m.**

(Secretaries of Centres and Groups are requested to send in particulars of any changes in programmes, mentioning subject, author, place, date and time of meeting; summaries of proceedings at meetings (which should not exceed about 250-500 words) and any other local news are also welcome.)

1946.

Feb. 4th. MR. P. HARTILL on **Illuminating and Illusion.** (*In the Electricity Showrooms, The Headrow, Leeds.*) **6 p.m.**

Feb. 4th. MR. W. J. G. DAVEY on **Short Cuts in Illuminating Engineering.** (*In the Sheffield University, Western Bank, Sheffield*, 10.) **6 p.m.**

Feb. 5th. MR. W. J. G. DAVEY on **Street Lighting with Special Reference to Gas.** (*In the Electricity Showrooms Market Street, Huddersfield.*) **7 p.m.**

Feb. 6th. MR. IMRIE-SMITH on **Industrial Lighting.** (*In the Liverpool Corporation Electricity Showrooms, Whitechapel, Liverpool.*) **6 p.m.**

Feb. 6th. MR. T. S. JONES on **School Lighting.** (*In the Minor Hall, Oxford Street, Newcastle-upon-Tyne.*) **5.45 p.m.**

Feb. 7th. Shop Window Lighting. (*To be held at Pontypridd.*) (*Cardiff Centre.*)

Feb. 7th. MR. W. R. STEVENS on **The Trend of Fittings for Fluorescent Lamps.** (*In the Institute of Engineers and Shipbuilders, 39, Elmbank Street, Glasgow, C.2.*) **7 p.m.**

Feb. 7th. MR. N. C. HODSON on **The Practical Application of the Lighting Code to the Spinning and Weaving Section of the Cotton Trade.** (*In the Reynolds Hall, College of Technology, Sackville Street, Manchester.*) **6 p.m.**

Feb. 8th. MR. W. R. STEVENS on **The Design and Characteristics of Lighting Fittings.** (*In the Heriot-Watt College, Chambers Street, Edinburgh*, 1.) **6 p.m.**

Feb. 14th. DR. G. O. STEPHENS on **Fluorescence.*** (*In the Bradford Electricity Department Showrooms, Sunbridge Road, Bradford.*) **6.45 p.m.**

Feb. 17th. MR. R. GILLESPIE WILLIAMS on **Stage Lighting.** (*Cheltenham.*)

Feb. 20th. A paper on **Street Lighting.** (*In the Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.*) **6 p.m.**

*Attention is drawn to the fact that this lecture, the authorship of which was inadvertently incorrectly stated in the original Syllabus, is by DR. G. O. STEPHENS.

Short Cuts in Illumination

At the recent opening meeting of the I.E.S. Glasgow Centre, Mr. F. M. Hale was installed as Chairman in succession to Mr. E. M. Hood, to whom a vote of thanks for his services in office was passed unanimously. Mr. A. M. Rankin is acting as temporary hon. secretary in place of Mr. M. W. Hime.

Mr. W. J. G. Davey gave a paper on "Short Cuts in Illumination," illustrating his methods by the use of graphs and charts. He showed how by these means the labour of calculations could be lessened and mentioned that he hoped shortly to embody these ideas in a printed brochure.

Exhibition of Scientific Instruments and Apparatus

The holding of the thirtieth exhibition of scientific instruments and apparatus organised by the Physical Society has been announced to take place at the Imperial College of Science and Technology (Imperial Institute-road, S. Kensington) during January 1-3, 1946. One is glad to note the resumption of this exhibition which, prior to the outbreak of war, was an annual event.

Obituary

F. CHARLES RAPHAEL.

We record with regret the death of Mr. F. Charles Raphael, a Fellow of the Illuminating Engineering Society and a member of long standing. Mr. Raphael was also a member of the Institution of Electrical Engineers and of the Association of Consulting Engineers. He was in practice as a consulting engineer, and in I.E.S. discussions not infrequently expressed an original and independent view on lighting problems. We are informed that Mr. Raphael's practice has been taken over by Mr. R. W. H. Couzens (of Messrs. Couzens and Brown, Westminster).

Bright Light Sources

by Dr. J. N. ALDINGTON

(Summary of a paper read before the Illuminating Engineering Society in London on Dec. 11, 1945.)

The paper on this subject read by Dr. Aldington on December 11 was essentially a supplement to the earlier paper read by him on November 14, 1944 (Part I), which was concerned exclusively with incandescent filament lamps. This second instalment (Part II) was concerned with electric discharge lamps, Dr. Aldington was able to refer not only to certain forms of lamps which have been evolved during the last few years, on which little could be said during the war period, but also to some later varieties still in the experimental stage.

Conditions of High Brightness.

The paper was presented in the brilliant manner which we have come to associate with Dr. Aldington, and was illustrated by many neatly performed and most fascinating demonstrations. The hall of the Lighting Service Bureau was filled to capacity, and although the delivery of the lecture and the experiments occupied nearly an hour and a half, members remained to pursue a keen discussion afterwards.

In opening his paper Dr. Aldington explained the phenomena occurring in an electric discharge, throwing an image of the arc on the screen and drawing attention to certain areas of exceptionally high brightness near the electrodes. He also analysed the conditions which enable a discharge to produce a light source of high brightness. Of these the chief are (a) high luminous efficiency, (b) high voltage gradient, and (c) high current density. The inter-relation of these factors was discussed. The choice of material may affect these relations considerably—for example, in a mercury vapour lamp the efficiency increases progressively with increases in the voltage gradient up to about 55 L/W—but this does not hold true with some other gases and metallic vapours.

Air-Cooled and Water-Cooled Lamps.

The lecturer then passed on to the description and illustration of various air-cooled and water-cooled mercury vapour lamps, starting with the simple form of MB/D lamp having a brightness of the order of 800-1,000 stilb and then passing to the 500-W. and 1,000-W. MD/H water-cooled lamps in which a brightness as high as 30,000 stilb can be attained. It was mentioned that the development of similar lamps consuming up to about 15 kW. was in progress and specimens of some of the latest lamps, consuming too much current to be put into operation in the lecture theatre, were exhibited. In some forms of lamps, for instance, the type ME/D 100-W. lamp even higher brightnesses, up to 40,000 stilb, are attained.

As a result of the consideration of the relations between length of arc, arc voltage and arc current, Dr. Aldington was able to make some predictions of possible future developments with greater loading and smaller arcs. It was estimated, for instance, that in a 30-kW. lamp, with arcs from 10 mm. down to 5 mm., a centre brightness ranging from 146,000 up to 414,000 stilbs might theoretically be reached. Particulars were given of an actual experimental 10-kW. lamp yielding 75,000 stilb.

Condenser Flash Lamps.

Other features in design which were the subject of discussion were the configuration of electrodes, the utilisation of lamps of high brightness with mirrors and projection systems and possible colour modulations of the mercury arc, such as those achieved by the introduction of cadmium. In a further section of the paper the current control of ME lamps and the use of incandescent

auxiliaries in starting were reviewed, after which the design and performance of condenser flash lamps, capable of giving an intensely bright light for a very short period, were dealt with and illustrated by numerous striking experiments. Apparently it is the product of the intensity and the duration of the flash which determines the photographic effect. Dr. Aldington, however, mentioned experience—and showed by an actual experiment—that this may not hold for the effect produced on the visual mechanism. Thus the effect on the eye of 50 lumen-seconds derived from a 10-watt tungsten lamp operating at 5 L/W and exposed for one second is very much less than that of 50 lumen-seconds derived from, say, 10^6 lumens operating for 50 microseconds.

APPLICATIONS OF INTERMITTENT LIGHT.

The practical applications of such intermittent light, for example, in connection with the cinema industry, were discussed by the lecturer and subsequently by several members of the audience. Such flash lamps have done good service during the war for photographic reconnaissance. Their stroboscopic effect can be utilised very simply to cause objects in rapid motion to appear stationary—an effect obtained less readily with neon lights in the past. This was beautifully illustrated by the lecturer in several experiments.

The paper gave rise to an animated discussion, some members of the audience raising points in connection with design, whilst others commented on applications, for example, for episcopic projection and in the cinema field generally. Perhaps the suggestion that evoked most discussion, however, was that relating to the relatively greater visual effect of impulses consisting of intensely bright light exhibited for very short periods. It appeared that this, if confirmed, might lead to important results in connection with illuminating engineering; though it was pointed out by several observers that photometric experience, as exemplified in Talbot's Law, appeared to be opposed to this impression.

At the conclusion of his paper, Dr. Aldington paid a generous tribute to the work of other laboratories in this same field. He indicated, in fact, that the resources of the British Thomson-Houston Co., Ltd., the General Electric Co., Ltd., and Siemens Electric Lamps and Supplies, Ltd. (with whom Dr. Aldington is associated), had been pooled in this connection during the war period. The outstanding progress reported was the result of their joint efforts.

Essay Competition for Schools

The idea of organising essay competitions in schools, pursued with success by the I.E.S. Birmingham Centre, has recently been developed by the Newcastle Centre. At their opening meeting on October 3, Mr. E. C. Lennox referred to the success that had attended the lectures on Illumination delivered to schools in the North-Eastern Area, as a result of which essays were sent by a number of pupils. The first prize was awarded to Miss Joyce Kemp, of Gateshead Grammar School; the second to Eric Miller, at the same school (who, however, was not able to be present to receive his award); and the third to Dorothy Leech, of Heaton Girls' High School.

Following this pleasing event, the new chairman of the Centre, Mr. W. Cross, called on Mr. T. O. Freeth to deliver a paper on Domestic Lighting. This was very well received by the audience, which included representatives of the Electrical Association for Women.

We learn that Dr. J. W. Whittaker, who has been long associated with the Huddersfield Technical College and has been a valuable member of the I.E.S. Huddersfield Group, has now taken up an appointment in India.

Street Lighting

In a paper recently read before the I.E.S. Leeds Centre, Mr. N. Schofield contributed a useful review of street lighting, recalling the main recommendations of the 1936 M.O.T. Report, which serves as a starting point for future developments.

The paper lead to a good discussion, in the course of which some familiar problems were discussed—such as the value of photographs as evidence. Mr. Schofield admitted that a photograph may make a good installation appear bad or *vice versa*. Mr. Firth emphasised the importance of the selection of the site for the camera, and Mr. A. Wilde raised the question whether there ought not to be a British Standard Specification for photographs taken to illustrate lighting.

Mr. J. G. Craven also discussed a fundamental problem, the waste of light when rays fall on places where there is no background to be illuminated, a case that is partially met by the use of assymetric reflectors.

Several speakers referred to the great value of light coloured backgrounds at suitable spots so as to provide a bright area against which objects on the roadway could be seen in silhouette. In this connection Mr. Wilde recalled the offer of a prominent advertising firm in Leeds to put up and maintain hoardings at suitable points where a background was needed—an offer, however, which was not accepted, though the proposal is an interesting one.

We learn that Mr. J. G. H. Sheridan, who is the managing director of the Strand Electric and Engineering Company, Ltd., has been appointed to the chairmanship of the company in succession to Mr. F. L. Blow, and will in future combine the roles of chairman and joint managing director. Mr. S. E. Earnshaw, for many years a director, has now become joint managing director, and Mr. L. G. Applebee (an I.E.S. Fellow and a member of long standing) has been appointed to the Board.

Good News

During the period of the war readers of "Light and Lighting," and I.E.S. members in particular, have been very forbearing—acquiescing in the diminished size of this publication and other drawbacks arising from war conditions, and in some cases waiving their right to receive copies.

These difficulties have been occasioned mainly by the shortage of paper and the resulting restrictions, which have not yet been withdrawn.

There has recently, however, been a small but useful increase in the permissible allowance of paper, which it is hoped will be extended by degrees.

This concession, together with certain economies that have been found possible in the choice of paper, etc., render it no longer necessary to ask I.E.S. members to forgo copies to which they are entitled. Accordingly, **starting with the next (January) issue of "Light and Lighting," copies will be sent without exception to all I.E.S. members.**

The position in regard to **the I.E.S. "Transactions"** is somewhat more difficult. Nevertheless, it is proposed to adopt the same procedure in this case, and in future to send ordinary issues to all I.E.S. members—though it may still be necessary, in the case of papers of exceptional length or of a somewhat specialised character, to distribute copies only to those I.E.S. members who specifically ask for them, as has been done on several occasions during the past year.

Coloured Glass

The main item at the meeting of the Physical Society Colour Group on November 14 was a lecture by Mr. J. G. Holmes, entitled "Colorimetry in the Glass Industry."

Mr. Holmes opened his lecture with a definition of glass, and showed how recent knowledge of the glassy state has enabled the theories of modern colour chemistry to be applied to glass, to explain or to predict the effects of mixing various oxides in the batch. He explained why coloured glass becomes darker and more red when heated, and why pure red and blue coloured glasses can be produced, but not pure spectral green glasses.

The main part of the lecture was concerned with convenient methods of measuring colour and with approximate methods of calculation. The three colour co-ordinates XYZ could be used and, although glass has the property of colour because it subtracts some region of the spectrum from the light passing through it, the usual additive trichromatic theory was suitable for calculation of transmission factor and of colour. Several ingenious methods of calculation were illustrated, including a special slide rule for transmission factor, and special graph paper for colour co-ordinates, emphasis being placed on the need for getting an approximate result quickly rather than very accurate result after much labour. Measurement of colour was best done by spectrophotometry, although a colorimeter or a comparison photometer were good for control purposes. Mr. Holmes expressed doubts about photoelectric methods of colorimetry in industrial laboratories unless the instruments were in continual use, because the ease of observation was offset by the troubles of maintaining accuracy.

One of the outstanding applications of colorimetry has been the preparation of standard specifications for coloured light signals, and these have become increasingly precise as colorimetric knowledge and technique have advanced. Mr. Holmes outlined the growth of the standards for railway signal colours and showed how the experiments made early in the war are now being applied to a reconsideration of coloured signal lights. The properties of various important colouring oxides were illustrated, and it was shown how the effects of using different light sources could be predicted.

The discussion after the lecture dealt mostly with the colours of "bloomed" surfaces, used for reducing the reflection losses in optical instruments.

It was an interesting point that if the thickness of the film was either very small or twice the best thickness, the reflection factor was roughly double the calculated value, due to reinforcing interference of the reflected rays.

One of the slides showed a purple glass whose transmission curve was roughly the inverse of the visibility function, so that a spectrum viewed through this glass was of reasonably uniform brightness from blue to red instead of being brightest in the yellow-green, and Mr. Holmes asked if any of his audience could find a use for this glass.

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Cold Cathode Lighting

Summary of a paper read by Mr. Henry A. Millar before the I.E.S. Liverpool Centre on Nov. 8, 1945.

Cold cathode lighting is becoming increasingly popular in the United States. This is evident from the provocative arguments in regard to the respective methods of cold cathode and hot cathode methods, which have replaced the "incandescent lamps versus discharge tubes" controversy, formerly usual.

In this country the transition from war-time to peace-time production and the development of new lighting technique are beset with difficulties. Nevertheless, there is every reason to believe that, for some special applications, cold cathode tubing will have a field of its own.

A cold cathode tube consists essentially of a glass tube, either clear, coloured, or coated with a fluorescent material, fitted with an electrode at each end and filled with rare gas or mercury vapour at low pressure. The standard 80-watt fluorescent lamp is provided with electrodes (or cathodes) which emit electrons thermionically. Heaters are used to start the discharge, and the electrodes operate at a temperature of about 900° C. In contrast, the cold cathode tube is fitted with plain, cylindrical, or cup-shaped electrodes, which depend on ionic bombardment for electron emission and which operate at much lower temperatures. Hence a cold cathode tube may be defined as a luminous discharge tube in which the cathodes are operated at approximately the same temperature as that of the arc stream or luminous column.

In view of present-day interest in atomic energy, some reference to the mechanism of light production in gas discharges may be of interest. The conception of the atom as a kind of planetary nucleus surrounded by electrons with different orbits is familiar. The atom now belies its name. It has come to be regarded not as an indivisible particle but as a constellation of forces standing on the borderland between matter and energy. In the cold cathode tube light is produced by the projection of free electrons from the cathode resulting in ionisation of the rare gas or vapour contained in the tube. Ionisation may, indeed, be regarded as the removal of an electron from its parent atom. The nucleus carries a positive charge, which normally balances the aggregate negative charges carried by its electrons. Removal of one or more electrons will therefore result in a positively charged molecule. This is called an "ion."

The output of a light source may be described in terms of its spectral distribution. In the case of cold cathode tubes the gas and vapour fillings are monatomic; i.e., they have one atom per molecule and their spectra are made up of lines. According to Bohr's theory, light is emitted whenever the atom changes from one energy state to another. The wavelength of this light may be expressed directly in terms of the energy change. The energy changes in the luminous discharge tube occur primarily as a result of collisions between free electrons and atoms. There are limits to the amount of energy the atom can accept. Collision with the atom may result in an elastic rebound, with little or no transfer of energy.

Extra energy transferred from an electron is, however, released as radiant energy of appropriate wavelength. Helium has a component in almost every part of the visible spectrum and the output from cold cathode tubing consists of light of many different wavelengths, distributed throughout the spectrum. In the case of the hot cathode fluorescent lamp the efficiency and the range of available colours are greatly increased by the internal coatings with phosphorus which respond to ultra-violet radiation and emit light in the visible range. In the early days of neon tubes the fluorescent effect of tubes of canary glass, containing salts of uranium, was used to get a green effect. Coatings of fluorescent materials, may, however, now be adopted.

The extended application of cold

cathode lighting for interiors in this country is still to come. It should, however, form an excellent medium for luminous pictorial display lighting in hotels, restaurants and cinemas, etc. When used as a subsidiary to the general lighting scheme (preferably concealed fluorescent lighting) very attractive effects can be obtained. A merit of cold cathode tubing is its flexibility; being of reasonably small diameter it can be easily fashioned into any desired outline.

One obvious application is for luminous friezes. The tubing is mounted direct on fire-resisting wall board with provision at the back for the housing of auxiliary gear and connections. Ready means of access for maintenance, etc., must also be provided. In view of the rather high voltage special precautions must be taken in wiring, and the sanction of the local fire salvage department and other interested authorities must be obtained. Electrodes may be concealed in the panel. Red, blue, and green light may be provided or separate circuits may be combined in any desired proportions.

Until fairly recently the development of cold cathode tubes for lighting purposes was hampered by the necessity of high voltage operation: pressures of over 200 v. per foot of tubing being often used for tubes of 20 mm. diam. A type of tube recently introduced, however, operates at 430-460 v. and requires a striking voltage of only 720. This tube has an initial efficiency of 40.3 lumens per watt and a rated life of 8,000 hours. Starting is instantaneous, no switch or starting device being needed. It is available in white, warm white, or "daylight" colours. Under normal conditions the brightness is 1.540 foot lamberts. Such tubes can be connected in pairs in the same manner as hot cathode fluorescent lamps and by adopting the usual dual circuit methods stroboscopic effects can be almost entirely eliminated. Within reasonable limits rise in ambient temperature does not decrease efficiency.

The life of hot cathode fluorescent lamps is usually determined by exhaustion of the heated electrode emission coating. In well-designed cold cathode lamps there is no appreciable heating of this kind. Much of the high initial loss in light output of hot cathode lamps is due to reduction in effectiveness of the fluorescent powder, caused by the action of the ionised mercury vapour. Cold cathode tubes operate at a considerably lower current density, and the depreciation throughout life is accordingly less.

The following data, from an American source, are given for two cold cathode lamps operated on one duo-ballast:—

Average tube life (hours)	10,000
Total lumen output per tube ...	2,200
Lumens per watt of tube	52.4
Lumens per watt (inc. reactor loss)	41.5
Overall power factor, per cent.	99
Primary wattage	109
Amps.—capacity tube	0.118
Amps.—inductive tube	0.122
Surface brightness of tube (c.p. per sq. in.)	3.4

Power Factor Correction

At a meeting of the I.E.S. Huddersfield Group on December 4, Dr. E. C. Walton gave a lecture entitled "Power Factor and the Lighting Engineer."

The question of the power factor of lighting circuits, said the lecturer, had only recently entered the field of the lighting engineer, due to the chokes and transformers associated with discharge lighting. Dr. Walton showed that fluorescent lamps had a power factor of about 0.5 without capacitor correction. He also showed a number of charts with the aid of an epidiascope giving the various capacities required for correction.

The lecture was well illustrated with the aid of a double beam oscilloscope, which showed the voltage and current waves simultaneously.

The fact that the power factor should be corrected was well proved, especially in the case of consumers paying for electrical energy on the "maximum demand" scale of charges.

The Efficiency of Intermittent Light

(*Communicated*)

A very interesting idea is suggested in Dr. Aldington's paper (see p. 176), i.e., that a gain in visual effect may possibly be obtained when, instead of a steady and continuous exposure of light for a given period, we develop the same lumen-hours, but present it as a very bright light for a very short period.

It appears that the physical efficiency of a flash-lamp operated as described by the author may be exceptionally high. It is also easy to understand that in degree of visibility at a distance and in power to attract attention, the intermittent powerful lamps may be much the more effective, as is inferred from experience with flashing signal lights.

But there is a suggestion that we have something further than this, namely, an actual gain *in illuminating value*. A comparison on this basis will always be difficult when one has to compare an obviously flickering light with one of steady brightness. It can, however, be made easily if the intervals of brightness and darkness succeed each other so rapidly that a continuous light appears to exist. This is the principle of the familiar Talbot disc mentioned by several speakers in the course of the discussion. A disc with a variable aperture rotates at great speed in front of the source, and the resultant illumination, within wide limits, is known to be exactly proportional to the percentage area of the disc, which consists of open sector.

The so-called Talbot's Law, associated with this apparatus, leads to the conclusion that, for a given output in lumen-seconds, no apparent gain in illuminating efficiency, in a visual sense, can occur when its duration is diminished and its intensity correspondingly increased. But it does seem possible that this inference may not apply when the intervals of time are exceedingly small and the phenomenon of "persistence of vision" comes into play. We all know that, for a very brief interval after the stimulus is withdrawn the sensation still persists. Is it therefore necessary to stimulate the eye for this brief period? Can we secure the requisite illumination merely by "filling in the gaps" with light as soon as the impression begins to weaken? In other words, can a law which applies to intervals of, say, tenths or hundredths of seconds, not apply in the same degree when we are concerned with 1,000ths, 10,000ths, or 100,000ths of seconds? This is a question for the physiologist, who should, however, take into consideration that an appreciable time is also needed, presumably, to create the sensation of light in the eye.

So far we have considerd only the luminosity excited by the discharge of electricity through gas or vapour. If, however, a fluorescent coating is excited by this discharge, exactly the same query arises *de novo*. Is there a similar possible gain in efficiency if the stimulus is withdrawn only for the period during which the phosphorescence of the tube endures and before the glow has appreciably weakened?

Finally, there are yet two other ultimate questions that may be raised. Firstly, what is the effect on the endurance of the tubular source of such very short flashes? Would its life be much less than that of a similar source yielding steady light? This is a question which Dr. Aldington could doubtless answer from his experience.

Secondly, there is the question—which Dr. Aldington himself mentioned in this paper—whether such an intermittent illumination would be in any degree fatiguing to vision? This is again a problem for the physiologist. As, however, the eye endures without discomfort the light from lamps running on ordinary a.c. circuits, one would imagine it would be even less affected by very much more rapid fluctuations—provided always that they take place so quickly that one has the impression of a continuous light.

Colour in the Factory

In the annual report of the Chief Inspector of Factories (Sir Wilfred Garrett), attention is drawn to the great changes which the war has brought about in industry and to the new outlook on factory problems. "A factory is a place where goods are made, and they must be made economically and profitably or we will get neither goods nor wages; but also we must consider that a factory is a place where people spend one-third of their working lives, and must, therefore, be so run that the well-being of the worker is secured."

A special instance of this new outlook is afforded by the movement towards introducing positive colour into the interiors of factories, based upon "a deep revolt against the aesthetic starvation imposed by unrelieved war work." Inspectors report considerable benefit from the movement. In making the factory a place of human habitation the introduction of live colours is an essential element.

The report, however, conveys a certain warning. There is an impression that great improvements have been made in all the amenities required by the Factory Act. This belief, apparently, is based on the conditions found in the comparatively few factories especially built or adapted for war production. "Taking the factories as a whole there is an immense amount of leeway to be made up." This, undoubtedly, is true of industrial lighting.

Floodlighting

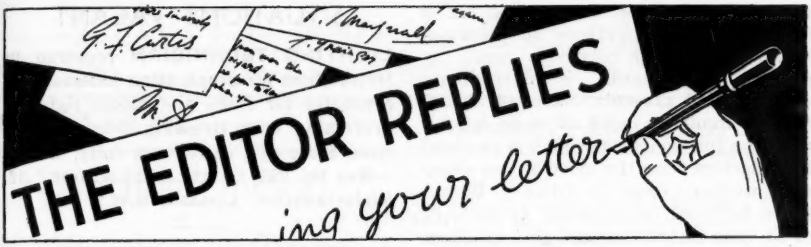
At a meeting arranged by the I.E.S. Nottingham Centre in the Derby Corporation Electricity Department Lecture Theatre on December 7, Mr. W. M. Peirce gave an interesting talk on "Modern Floodlighting Practice," in the course of which he showed a variety of slides illustrating modern methods and indicating how special effects could be obtained. The paper gave rise to a keen discussion. We notice that Mr. S. R. Doxey, who laid special stress on the floodlighting of parks and gardens, was less sanguine about the treatment of buildings—raising the familiar objection that floodlighting from below gives "unnatural" effects, as compared with daylight, which comes mainly from above. This is doubtless often true, both for exteriors and interiors; but it should be remembered that daylight itself varies immensely in intensity, direction, and degree of diffusion, according to the time of day and climatic conditions.

Registration of Engineers

The registration of engineers is a topic that is exciting attention in the United States and figured in the address of their I.E.S. President (Mr. S. B. Williams). Practice in this respect varies in the different States, but in general there is a trend towards registration as an indication of professional status on the part of those engaged in the design of lighting installations—although, apparently, it is not specifically that of the illuminating engineer, but of something more general. A committee is, however, studying means of making registration of more practical benefit to those engaged in illuminating engineering. One notes here a tendency in America parallel to that in this country where for some time an I.E.S. Committee has been preparing plans to enable competent lighting engineers to get some form of "hallmark."

Another interesting report from the U.S.A. is to the effect that the number of universities who are training engineers specifically in illumination has increased and continues to increase year by year—notwithstanding the attractions of such dramatic fields as radar, atomic energy, and jet propulsion. In this connection reference is made to the entry of young women into illuminating engineering, several of whom are now I.E.S. students.

In this country there have been for a number of years women I.E.S. members—though not so many as one could wish. On the other hand, it must be owned that developments in education in illuminating engineering at colleges have not been as yet very encouraging. The present conditions are, however, quite abnormal owing to the call up of so many young people in addition to those already in the Services.



A letter from Mr. A. R. McGibbon raises a point of interest in connection with **daylight values** specified in **the I.E.S. Code.** The comparison of values requisite by natural and artificial light has long been recognised to present inherent difficulties. Indeed, some architects have expressed the view that common values of illumination are impracticable, though there is less objection from this standpoint now, when the level of artificial illumination has been so substantially increased.

Mr. McGibbon, however, raises a somewhat different point. By day our eyes are adapted to very much higher levels of illumination than are usual by artificial light. Therefore, he argues, when **artificial light** is recommended **to supplement daylight** in the darker regions, some higher level of illumination than that indicated in Part II. may be necessary.

This is a fair comment. I think, however, the answer is that in such cases the actual value of natural illumination in parts of room remote from the window is usually much lower than is commonly supposed. Thus, in a well-lighted room with which I am familiar, the illumination at the far end may be only 0.2 ft.c. or less when the illumination near the window is 100 ft.c. or more. Therefore the addition of, say, 5-10 ft.c. from artificial sources is a very great improvement and, in actual experience, seems to meet the need.

Referring to the notes on **Street Lighting** in our last issue several people have expressed approval of the suggestion that **avoidance of glare** ought to be a major aim in post-war practice, and expressed a preference for some form of **"cut-off" system.** Elimination of glare is certainly a great benefit, and designers of street lighting equipment would do well to take this viewpoint into consideration. At the same time, the limitations of a cut-off system which, unless carefully designed, is liable to give rise to somewhat patchy road brightness should be understood, especially when conditions impose relatively wide spacing.

The ideal is uniform road brightness. In practice, however, very great variations can scarcely be avoided. The main consideration seems to be to prevent *sudden* contrasts. It is here that the abrupt cut-off of some of the early and rather extreme systems, using deep opaque reflectors, gave offence. It is essential that the change in brightness should be gradual and that "pools of darkness" do not occur.

I still occasionally meet folks who are reluctant to give up the idea of **illuminated barrage balloons**—or a more scientific variant thereof—for lighting large outdoor areas. The idea has been frequently condemned as visionary by public lighting engineers, who point to various obvious difficulties. Amongst these are the interference by climatic conditions, the casting of shadows by houses, and the swaying of the illuminated balloons or other suspended objects in wind, which would give rise to flickering effects.

Advocates of the system have, however, counter arguments. They urge, with some justice, that moonlight delivered through a light mist is in some

respects ideal for street lighting. It is free from glare, produces an illumination which, though relatively weak by peacetime standards, is exceedingly uniform, and presents overhead an extensive luminous area of even brightness, the full benefit of which is received by reflection from the more or less shiny road surfaces usual in cities. Illuminated balloons, at a height of 5,000 ft. or so, it is claimed, would give an effect resembling that of misty moonlight.

There are few nights when the intervening mist would not be sufficient to soften any inconvenient shadows; the use of a number of separated sources (in place of one moon) would also have a diffusing effect. Furthermore, at a height of 5,000 ft. steady winds are the rule, and the sources would not oscillate erratically. In reply to the argument that the system would be useless in a dense fog, it is urged that such a condition is quite exceptional, and that in fogs even lighting from lamp-posts likewise becomes almost useless.

So runs the argument. I will say only that I would like to see **experiments tried,** perhaps as an adjunct to spectacular lighting at an exhibition, though I foresee that the misty atmosphere which helps to produce diffusion may also occasion very considerable absorption of light. The system, therefore, could scarcely prove an efficient one.

The possibilities of lighting from masts, at moderate altitudes ,seem likely to invite consideration for extensive open spaces.

Atmospheric absorption, at distances of, say, 20 to 100 ft., is, however, something one would like to know more about. I hardly imagine it can be of material consequence in ordinary interior lighting. In smoky industrial interiors—foundries and the like—it does play a definite role, and I suspect it is not without influence at the distances met with in lighting streets, airports, etc., even when the atmosphere appears relatively clear to the eye.

SITUATIONS VACANT

LIGHTING TECHNICIAN required in Nottingham for preparation schemes and estimates for stage and colour lighting, preferably with Drawing Office experience. State age, experience fully, salary. —Box No. 263, "Light and Lighting," 32, Victoria-street, London, S.W.1.

ELECTRICAL MANUFACTURERS require for London Lighting Department an energetic, well-educated man. Lighting and electrical training and commercial experience essential. For technical commercial office work with all types of lighting fittings and illumination. Correspondence, specifications, sales, etc. British national. Medical examination.—Detailed particulars and salary required to Box No. 150, "Light and Lighting," 32, Victoria-st., London, S.W.1.

LIGHTING FITTINGS DESIGNER, British, required for Central London by large manufacturers. Commercial and industrial, lighting equipment for tungsten, fluorescent and discharge lamps. Electrical and illumination training and experience essential. Medical examination.—State salary and full particulars to Box No. 151, "Light and Lighting," 32, Victoria-st., London, S.W.1.

IMPERIAL CHEMICAL INDUSTRIES, LTD., Plastics Division, invite applications for the appointment of ILLUMINATING ENGINEER to undertake development work on the application of plastics in the lighting field. Knowledge of plastics is not essential, but good technical appreciation, coupled with practical experience of design and layout, is required. Minimum qualification H.N.C. Experience of laboratory control would be an advantage.

Write, quoting D.1629Xa, to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 367, York House, Kingsway, London, W.C.2, for application form, which must be returned completed by January 28, 1946.

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